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EDWARD DRINKER COPE.

Professor Edward Drinker Cope died at his home in Philadelphia, April 12, 1897. He was born in Philadelphia, July 28, 1840. His family belonged to the Society of Friends, and was one of the oldest in the State; his ancestor, Oliver Cope, being one of the associates of William Penn in the establishment of the colony. His grandfather, Thomas Pym Cope, was one of the merchant princes of the city.

He received his early education at the hands of a private tutor and in the Westtown Academy. In these early years he had a great love for nature; soon it grew into an overpowering passion, and he fairly haunted the museum of the Academy of Natural Sciences, and here he began his investigations. We cannot here catalogue the long series of papers—nearly a thousand in number—which followed, but it may be of interest to know that the first one was published when its author was not nineteen years' old, and dealt in a masterly way with the classification of the salamanders.

In 1859 he studied the reptiles in the Smithsonian Institution, returning the next year to Philadelphia to work again for three years in the Academy. Then followed for one year study in Europe; not the study of to-day under the direction of a professor, but study of the specimens in the greater museums from London to Vienna.

Upon his return to America in 1864 he accepted the professorship of "Comparative Zoology and Botany" in Haverford College, where he remained until compelled by ill-health to resign in 1867. It is interesting to look over the Haverford Catalogues of those years and to see how thoroughly his courses were comparative, or what to-day is called morphological; and how little they had in common with the descriptive zoology and the analytical botany then taught in almost every American college.

During these early days his spare moments were devoted to the reptiles, and to the very last these forms held a prominent place in his work. Unlike his American predecessors he realized that there was more in a snake, a lizard or a frog than scales and color pattern; he knew that they had brains and viscera and skeletons, and even before he was twenty-five he had worked out a classification of the Anura, which is still the basis of all subsequent work.

It was this study of the skeleton which fitted him, in 1866, to take up the reptiles found in the marl pits (green sand) of New Jersey, and this was his introduction into the field of Paleontology, in which, for years, even to his death, he stood *facile princeps* in America, if not in the world. From this time on he was primarily a vertebrate paleontologist. At times, it is true, he turned to other fields and studied recent forms. He classified the snakes and lizards of North America; published a masterly synopsis of our frogs and toads, salamanders; he studied the fauna of our caves; he classified the fishes; and his work in each of these lines alone would have given him a reputation which many might envy. They were with him but side issues; he studied the recent forms for the light which they could throw on the forms of the past. And it was just this knowledge of forms both living and fossil—a knowledge which was wonderful in its detail and its accuracy, and even more surprising in the ease with which its minutest points were called forth when needed—it was just this knowledge which placed him as a peer of Huxley and Owen in the paleontological field.

From the New Jersey Dinosaurs he turned next to the Miocene fauna of Maryland and Virginia, and in 1868 he undertook the study of the air-breathing vertebrates of the Ohio Geological Survey. Here his studies showed that labyrinthodons and other huge monsters of the past must be grouped together as a distinct order Stegocephali, a generalization which has obtained world-wide acceptance.

In 1870 began his studies of the wonderful fauna buried in the rocks of our territories west of the Mississippi. Some little was known of these strange forms through the labors of Owen and Leidy, but Cope was in reality to open up a new field. In the year just mentioned he visited the Cretaceous of western Kansas and brought to light the huge reptiles so characteristic of that region. In 1872 the Bad Lands about the head waters of Green River, in Wyoming, were investigated; and in 1873 Colorado was the scene of his labors. Then followed his appointment as Vertebrate Paleontologist of the U. S. Geological and Geographical Survey of the Territories, under the direction of the late Dr. F. V. Hayden; and a year later (1874) the appointment to a similar survey, under the direction of Lieutenant Wheeler, of the lands west of the 100th meridian. Both of these positions were held by Cope continuously until all the surveys were merged in the present organization.

During these years Cope was in the field every summer, and in his investigations he visited and collected in every State and territory west of the Missouri. Not only did he collect himself, but he organized parties at his own expense, which were also almost continuously in the field. As a result he amassed a collection of vertebrate fossils from our western territory probably unequalled in extent and in variety. To this he was constantly adding by purchase from other parts of the world. Another result was an unparalleled series of papers from the pamphlet of three or four pages up to his huge quarto "Tertiary Vertebrates," and what was the more remarkable about this whole series was that the whole of these contributions to science were entirely his own work. He had no patience with the view that it is honest, that it is honorable, to hire others to do intellectual work, and that when payment is made for these services all title to the labor passes. Another characteristic of these same papers lies in this: that whether we have before us a hasty preliminary or a well-matured volume we are not in doubts as to what the author had before him. He at once seized upon the saliant and diagnostic features of his specimen, and described it clearly and intelligibly. There were no slovenly descriptions which might cover a dozen different things, and which might later be invoked in a dispute over a question of priority, and be made to fit the most desirable form.

It is not yet time to summarize all of these geological discoveries, to discuss the attempts to correllate the strata of the West with those of the Old World, to enumerate all the lines of descent worked out; but we may be pardoned if we mention a few, which, at the moment of writing, come to mind as of great interest. Here should be mentioned the reptilian giants Camarasaurus and Clidastes; Anaptomorphus, recently brought into such prominence in connection with Hubrecht's views upon the origin of the Primates; Phenacodus, the central stem of the higher mammals; the classification of the Theromorphous Reptilia, and the recognition of this group as the diverging point of Reptilia and Mammalia. This list might be easily extended almost indefinitely, as will readily be seen when we recollect that Professor Cope described nearly a thousand species of fossil vertebrates, and that, with every description there was an accurate conception of the position and relationships of the form described.

In lines other than paleontological his work was of the greatest value. The purchase, some thirty years ago, of the Hyrtl collection of skeletons of fishes—embracing some six hundred specimens—opened the way for a study of the fish-like vertebrates such as no other man has made. As a result he issued in 1871 a classification of the fishes, based upon structural characters, not on external form, which has been the foundation of all subsequent work in this direction, and which is rapidly replacing the older and more artificial systems of Cuvier and of Günther.

Cope's classification of the fishes is the only one that can be used by the student of paleontology. Besides this central work Cope published numerous papers upon the fresh water fishes of North and South America, and, wherever he touched the subject, he left his mark.

In the Batrachia and the Reptilia his work was of the greatest value. His synopsis of the Batrachia, based as it is on the entire structure of these animals, will long remain a standard for the American student; but in studying this work one must remember that its foundations were laid in its broader features, when the author was but twenty-five years of age. His small pamphlet on the osteology of the Lacertilia is a mine of structural facts, while his studies of the snakes, structural and systematic, cannot be ignored.

In the Invertebrates, Cope did but little; but one must not forget his studies of cave faunæ and his papers on the myriapods.

There was another side to Professor Cope's scientific work, that which dealt with theories of evolution. Professor Cope maintained in his earliest essays that the principle of Natural Selection, the very basis of Darwinism, could not be invoked as a *causa vera* to account for the origin of species and of higher groups. It did not explain the origin of variations, but could only act after variations had been produced to perpetuate and preserve those most advantageous to the organism. The cause of variation must be sought elsewhere, and he rehabilitated for this purpose Lamarck's early principle of the effect of use and disuse of parts. In this way he became the founder of the school of Neo-Lamarckians, in which his efforts were ably seconded by others, notably by Hyatt and Packard. He remained, however, until his death, the foremost advocate and exponent of this distinctively American school of philosophical biology.

His work in this line was not experimental, but rested rather on the evidence presented by fossil forms. In this way he could bring to his support a wealth of facts, accessible to no one else. His mechanical explanations were thoroughly and carefully worked out, and his views, like those expressed in his able paper on the homologies and origin of the types of molar teeth, were so cogently expressed that they made numerous converts to his theories.

This neo-Lamarckian view was first set forth in 1868, and was supported by numerous subsidiary theories advanced then and at later dates. Among them were the theory of "acceleration and retardation," the principle of "exact parallelism" so strikingly exemplified in the Anurous Batrachia, "homologous groups" and "consciousness in evolution." Later he turned to those more difficult evolutionary problems

—the origin of intelligence, the evolution of the ethical side of man, etc.—and expressed his views thereon in a series of essays which have attracted wide attention. These evolutionary essays were collected in a volume issued in 1887 under the title "The Origin of the Fittest." Later still (1896) these essays, together with his later contributions to the theory of descent, were summarized in a volume, "The Primary Factors of Organic Evolution;" a volume which several followers of Weismann have recognized as the ablest expression of anti-Weismannian views.

Scientific organizations the world over have expressed their appreciation of the attainments of Professor Cope. He has been elected an honorary or a corresponding member of many societies. In 1872 he was elected a member of the National Academy of Science; in 1879 the Royal Geological Society of Great Britain bestowed upon him the Bigsby gold medal, in recognition of his labors in the advancement of paleontological knowledge. In 1883 he was elected vice-president of the Biological Section of the American Association for the Advancement of Science, and in 1896 he was elected to the presidency of the same organization. In 1886, at the celebration of the four hundredth anniversary of the foundation of the University of Heidelberg, he received the honorary degree of Doctor of Philosophy, the highest honor the University could bestow. In 1889 he was elected Professor of Geology and Mineralogy in the University of Pennsylvania, and he held this position at the time of his death. He became the owner of THE AMERICAN NATURALIST in 1877, and since that time has been the senior editor of the magazine.

Professor Cope was a man of quick decision and of strong convictions. He did not believe in temporizing or acting from motives of policy. There were with him only two conclusions: a thing was either right or wrong, and when his decision was made, his course was clear. Compromise was foreign to his nature. These facts readily explain many things in his history. Personally he was a delightful companion. Gifted with facility and felicity of speech, and with experiences far beyond the run of the ordinary man, an hour in his presence was an hour not easily to be forgotten. How he enjoyed telling of his adventures and his battles; and if the joke were against him, its narration afforded him the more pleasure. Those who have heard him tell of the purchase of the skin of the long-tailed cat in Oregon will never forget the story.

Then how helpful he was. The treasures of his collection and the greater treasures of his intellect were open freely to all. If it would aid a fellow student or would solve a question, his most valuable specimens, even those as yet undescribed, were freely offered, and their bearings fully explained; a helpfulness often acknowledged by most of his fellow paleontologists in their published papers, and all the more noticeable from its rarity in other quarters.

Another characteristic of Professor Cope was his readiness to admit a mistake or to correct an error when shown the truth. Instances of this are numerous. In the pages of this journal, to cite a single example, he severely criticised the late H. B. Pollard, for his theory that the Batrachia had arisen from the Crossopterygian Ganoids. Scarce a year later he accepted the same view, and advocated it in his later publications.

He was a most indefatigable student, and his capacity for work was astonishing. His house was his workshop, and his collections fairly crowded the family out, so that they had to seek other quarters. Everywhere there were either books or specimens. The cellar was filled with alcoholic collections, the upper floor with skins and skeletons, while the other floors were almost solidly filled with fossils. Some years ago his mammalian fossils passed into the possession of the American Museum of Natural History, in New York City. At the time of his death he was engaged in working up the fossils found in the Port Kennedy bone cave.

Professor Cope was married to Annie, the daughter of Richard Pym, who, with their daughter Julia, now the wife of William H. Collins, Professor of Astronomy in Haverford College, survive him.

J. S. KINGSLEY.

RECENT LITERATURE.

Surface Features, Missouri Geological Survey.—Charles R. Keyes, State Geologist, vol. X, 543 pages with 22 plates and 24 figures.

Clay Deposits, Missouri Geological Survey, Charles R. Keyes, State Geologist, vol. XI, 622 pages with 39 plates and 15 figures.

Volume X, contains a report on the Physical Features of Missouri by C. F. Marbut, one on the Formation of the Quaternary Deposits by J. E. Todd and a Bibliography of Missouri Geology by R. Keyes.

The report on Physical Features is the first work of the kind undertaken by any State Survey with the view of covering the entire commonwealth. The different surface features are described and their origin traced by the application of the principles of physiography.

A broad gently undulating upland plain forms the most conspicuous feature of the surface. It is divisible into the Prairie region and